The Directionality and Relativity of Time and Space and the Qur'an

M.M. Taqui Khan

Time and space and in fact matter and energy came into existence from nothing with a Big Bang about 14-20 billion years ago. The visible universe was thus created not in time, but with time. The starting point which marks the zero time of the formation of today's visible universe, the first event was a dot 10^{-33} cm in diameter (Plank's length) in 10^{-43} sec (chronon). The dot was very hot at 10^{33} K, very dense, and in a highly ordered state (maximum negative entropy). At the instant of the creation of the dot, forces and energy were dissolved in time and space in a form unknown to physics because such conditions cannot be recreated in the laboratory. The dot then started to expand exponentially with time, doubling itself in every 10^{-24} sec for the first three minutes, till slowed down by breaking to a steady state.[1] There was also an accompanying drop in temperature and an increase in entropy. The arrow of time was thus set in the direction of the increasing entropy accompanying the expanding universe. Time flows from past to future in a series of events of cause and effect in such a manner that the effect always follows the cause.[2]

The universe is dynamic. The earth moves around the sun at a speed of 30 km/sec and the sun around the galaxy, the Milky Way, at 220 km/sec. The galaxies also move at different speeds in an expanding universe, as discovered by Hubble in 1927.[3] The rate of motion of a galaxy is directly proportional to the distance apart in the cosmos. The universe is still expanding uniformly at the rate of 186,000 miles/sec ($1/10^{th}$ the velocity of light) and its diameter is now about 10^{28} cm. Thus the universe has expanded

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[1] Steven Weinberg, *The First Three Minutes* (New York: Basic Books, 1977), pp. 14-44, 101-122.
[2] Stephen W. Hawkins, *A Brief History of Time: from the Big Bang to Blach Holes* (London, Bantam, 1988), pp. 15-37, 151-153.
[3] Paul Davies, *Space and Time in the Modern Universe* (Cambridge, UK: Cambridge University Press, 1977), pp. 85-115.

from the original state of a dot to 10 cm. The dot expanded in six stages to form our present universe.[4] The Qur'an says in the following and other ayahs: "It is God Who has created the heavens and the earth in six aeons." (57:4).

The six stages varied in duration and time scale from 10^{-24} sec to one billion years. The first two stages of the formation of the universe lasted for 10^{-5} sec, when energy was converted into matter and the creation of the micro or the atomic world. At the time of the creation of the dot, the four forces of nature—the strong and weak nuclear force, the electromagnetism, and gravity—were combined. The forces that became separate in the first two stages were the strong and weak nuclear forces. These forces converted quarks and other material particles (hydrons) into components of the atom, the neutron and proton. For every particle produced there was also its mirror image, the antiparticle. The Qur'an: "Glory be to God, Who created in pairs all things that the earth produces, as well as their own kind, and other things of which they have no knowledge" (36:36).

The first directionality or asymmetry was set up by the production of slightly more matter than antimatter. The antimatter either disappeared in a different world or was annihilated by interaction with matter to produce energy. The small excess of matter that remained formed the microcosms or the quantum world of particles of matter and atoms, varying in size from 10^{-20} cm to 10^{-8} cm. The shortest-lived particle in the quantum world has a half-life of about 10^{-23} sec and the longest-lived is the proton with a half-life of a few million years. The microcosm or the quantum world has its own fuzziness, which is a part of the system. We cannot access two of its properties at the same time. If we know the energy, the location of the particle in terms of space and time becomes fuzzy or a probability. This is known as the uncertainty principle, and plays a dominant role in the quantum world. This

[4] Joseph Silk, *The Big Bang* (New York: W. H. Freeman, 1989), pp. 170-239, 341-367.

The Directionality and Relativity of Time and Space principle distinguishes the quantum world from the macrocosm (the world of earth and planets) where every property is determined.[5]

For the next three minutes (the third and fourth stages), the formation of neutral atoms took place as the result of the combination of charged particles. This was by the operation of the third force of electromagnetism that both attracts and repels. The carrier of electromagnetism is the photon (the particle of light), which has a zero mass and a variable energy depending on its frequency. Photons have an absolute velocity of 186,000 miles/sec, which is a fundamental constant of nature. In the quantum fuzzy world the forces that operate are strong and weak nuclear forces and electromagnetism. The force of gravitation is very weak compared with these forces and does not come into play.[6]

In the last two stages, the formation of the universe, which lasted for a billion years, the scattered masses of the particles and atoms in space were brought together by the action of gravity. This force is totally attractive and is directly proportional to the masses that it attracts and inversely proportional to their distance apart. The collection of masses then formed the macrocosm, the stars, the spiral galaxies, and the planets. Beyond a certain mass (6 times the mass of our sun), the attractive forces become so huge that the mass explodes into a supernova and the remaining mass shrinks either to a neutron star or a black hole with enormous densities and gravitational pull. Stars avoid the gravitational crunch by the nuclear reactions that convert hydrogen into helium

[5] Paul Davies, *About Time: Einstein's Unfinished Revolution* (London: Penguin Press, 1996), pp. 126-183.
[6] Roger Penrose, "*The Large, The Small and the Human Mind*", Cambridge, UK: Cambridge University Press, 1988, 1-93.

and then to heavier elements. When the fuel is exhausted, they become either a neutron star or a black hole.[7]

It is of interest to assess the place of human beings in the scales of the microcosms or the macrocosm.[8] Humans occupy the most prominent place in the universe in terms of their life span and size. The life span is about 10^8 sec (100 years) in between 10^{-23} sec of a particle and 10^{17} sec of the universe. The size of the human being is about 2 times 10^2 cm compared with 10^{-20} cm of the particle and 10^{28} cm (50 billion light years) of the universe. The human beings combined in themselves the micro world, the macro world, and the world of conscience in a remarkable manner, qualifying them as the vicegerents of God on earth.

Relationship of Humans to the Universe

Time		Space
10^{17} (15 billion years)	Universe (Macrocosm)	10^{28} CM (50 billion light years)
10^8 Sec. 100 Years	MAN	$2*10^2$ CM
10^{-8} Sec. 10^{-23} Sec.	Quantum World (Microcosm)	10^{-8} CM 10^{-20} CM
10^{-31} Sec.	Big Bang	10^{-33} CM

[7] Roger Penrose, *The Emperor's New Mind* (Oxford, UK: Oxford University Press, 1989), pp. 149-217, 302-339.
[8] B. K. Ridley, B.K, *Time, Space, and Things* (Cambridge, UK: Cambridge University Press, 1994), 14-57, 109-150.

The Directionality and Relativity of Time and Space

In order to appreciate fully the ideas of space, time, and space-time, it is important to know that, though these concepts are basic, they are nevertheless problematic in character. Unlike straightforward observational phenomena such as color, volume, and hardness of materials, upon which everybody can agree, the notion of space time is so defused and so conceptual that people have continued to interpret it over the centuries. Today, however, there is still much uncertainty in the interpretation of these concepts.[9]

The concept of space originates from place, the container of material objects or beings or a group of objects. It may also indicate the volume of the container. Thus space has a positional quality and is also a container of objects. An empty space without a material object is inconceivable and in the same manner a material object can only be conceived as existing in space. If several objects are present in space, their relative position can be measured, either along a line with respect to distance from a point, x, or in a two dimensional plane with respect to two distances, from a point (x and y), or three distances in spaces from a point (x, y, and z). This forms the basis of the Cartesian coordinates of a point, x, y, and z. There is also a non-Cartesian geometry on the surface of a sphere, the Riemann's geometry. Another non-Cartesian geometry is Hyperboloid geometry on the surface of a Hyperboloid. The geometrical finds are different in the three systems of measuring space. For example, in Euclidean geometry, the sum of three angles of a triangle in a plane is two right angles. However, in Riemann's geometry, the sum is greater than two right angles. In Hyperboloid geometry, it is less than two right angles. The latter two geometries are used in the general theory of relativity to measure the curvature of space-time.[10]

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[9] Max Jammer, *Concepts of Space: The History of Theories of Space in Physics* (Princeton, NJ: Dover Publications, 1994), pp. 127-215.
[10] H. Reichenbach, *The Philosophy of Space and Time* (Princeton, NJ: Dover Publications, 1999), pp. 30-81.

For measuring distances in space, one should have a standard of length. The first standard adopted was 10^{-7} of the distance from the North Pole to the Equator. A standard one-meter platinum-Iridium rod then replaced it. The meter is still widely used as a measure of distance for scientific purposes. The standard of length is now based on electromagnetic radiation. It is 1650763.73 vacuum wavelength of orange red light emitted by krypton-86. Using this standard, one can go to very small wavelengths. The average wavelength of the visible light is 10^{-6} m. The wavelength of X-rays 10^{-10} m, the wavelength of an electron 10^{-12}, the wavelength of a proton 10-^{15} m, are the shortest distances measured so far. One can measure long distances to stars and galaxies in an electromagnetic unit of distance, the light year, which is the distance traveled by light in a year. The velocity of light is a fundamental constant of nature, which is 2.997925 x 10^{8} m/sec. Our own galaxy, the Milky Way, is about one million light years away. The sun is about 9 light minutes away, and the edge of universe is a billion light years away (10^{25} m). Thus the ratio of the distances between the smallest objects measures 10^{-15} m, and the longest distance, 10^{25} m, is forty powers of 10. The smallest length in physics, 10^{-35} m, is Planck's length, Planck's length is defined by:

$$(Gh/c^{(3)\,½}),$$

where G is the gravitational constant, h is Planck's constant, and c is the velocity of light.[11]

One of the achievements of Galileo was to introduce space as an independent entity for the realization of the inertia of a substance. Inertia is defined as the capacity of a substance to exert motion in other bodies and to resist its own motion. This idea was later developed by Newton to consider space an absolute entity.

[11] Hans Reichenbach, *The Direction of Time* (Princeton, NJ: Dover Publications, 1999), pp. 19-43.

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Einstein who considered space relative to motion and gravitation in his special theory of relativity, later abandoned the idea of absolute space.

The cause of the inertial mass of a body was considered to be due to the field created by other bodies on the substance. Thus the idea of field effectively replaced the idea of space as a carrier of forces and inertial mass. Every force in nature is associated with a field and is carried in the field by carriers. These carriers are either with or without masses. Gravitation, the mutual force exerted by the inertial masses, is the weakest force in nature and is carried in the field by the hypothetical particle, Graviton, with a zero mass. Gravitation is an attractive force directly proportional to the masses and inversely proportional to the square of the distance apart. The next force is electromagnetism carried by photons (particles of light) with zero mass. It is operative between two opposite charges (attractive) or between two like charges (repulsive). It also obeys the inverse square law as gravitation. Electromagnetism is a much stronger force than gravitation, since it produces very strong fields over short distances. Electromagnetism keeps together the constituents of an atom, the electrons and the protons, and, in chemistry and biology, the forces between atoms and molecules. The third force is the weak nuclear force, which causes the decay of a neutron to a proton, electron, and the neutral particle neutrino. The force is carried by charged particles with mass over very small distances. The strongest force in nature is the strong nuclear force carried by the charged particle gluon and confined to the nucleus of an atom. It binds the quarks together. The ratio of the four forces carried by the field, the strong, weak, electromagnetic, and gravitation is $1:10^{-2}:10^{-13}:10^{-39}$. Therefore, what was considered an empty space or a vacuum is not empty, for it contains fields and virtual particles that are created and destroyed in less than 10^{-24} sec.

A stationary object in space has no existence in nature because every object in nature has motion. Time is associated with

motion, and a stationary universe has no time. Time and events are thus linked. We should have a reference series of events to measure time or to have an idea of the flow of time. Since no two persons agree on time measurement, we should have a standard reference of time or a clock. Since time is one dimensional, the reference time in the Qur'an is the rotation of the earth around its axis, or the earth clock. The sun reaches the highest point at noon and the unit of time is a mean solar second, which is 1/86,400 of a mean solar day in a tropical year. Since the earth's rotational time has to be corrected for the effect of gravity to the extent of a few milliseconds per year, the standard of time adopted now universally is based on electromagnetic radiation emitted by cesium 133. The standard second is now defined as the duration of 9,192,631,770 periods of cesium radiation. Direct measurement of time up to the interval of 10^{-10} sec (100 picoseconds) is possible with sampling microscopes. The limit set by the measurement of very small time intervals is based on the electron's response to electromagnetic radiation, and this limit is 10^{-14} sec.

Laser pulses shorter than the picoseconds are available which can measure duration up to a femtosecond. In the case of long wavelength radiation the time is most easily measured by its energy. As the energy of the radiation increases, the time becomes shorter. Thus energy and time are conjugate properties joined by the quantum of action h (Planck's constant). The smallest time interval in physics is the time taken by light to cover the shortest distance, 10^{-35} m. This time is 10^{-43} sec, the chronon, the beginning of time itself at the Big Bang.[12]

For long time duration, special clocks are needed to measure time. The age of the earth is determined by the presence of radioactive atoms in the rocks, such as uranium and thorium, that have half-lives measuring millions of years. From the radioactivity of these minerals in the earth and extrapolation of the

[12] H.U.W. Rice, Time's Arrow and Archimedes' Point (Oxford, UK: Oxford University Press., 1996), pp. 49-114.

time of decay, the age of the earth is estimated now at 4½ billion years.[13] The radioactive sample obtained from the moon on the lunar expedition gives about the same age to the moon. The age of the cosmos is determined by the frequency of the light that we receive from the distant stars. This has been now estimated as 10-15 billion years from the beginning of the universe or the singularity at the Big Bang. The ratio of time measured from the shortest time of 10^{-23} sec to 10^{17} sec (10 billion years) is a factor of forty powers of ten. The same ratio was found for space in measuring distances as stated earlier. The reason is the standard for the measurement of distance and time or both based on electromagnetic radiation, which is the velocity of light, which connects time and space in a straightforward manner.

The heavens and the earth (time, space, and matter) are described in the Qur'an as *al-aamawat wa al-ard* respectively. The two are mentioned in many places in the Qur'an, for example: "Your Guardian-Lord is God, Who has created the heavens and earth in six stages" (7:54).

Here heaven and earth are used in their most general sense as time-space and matter respectively. Matter is distributed not only on earth but also on other planets and galaxies. The union of matter, time, and space is a singularity called the black hole. The Qur'an says: "Do not the unbelievers see that the heavens and the earth were joined together before We clove them asunder" (21:30).

This verse is a beautifully clear description of the starting-point of the universe as a singularity where matter, time, and space all existed together in the form unknown to science so far.

For people in the Stone Age, traditional time was the natural cyclic time, a regular and periodic repetition of the events and phenomena of nature. It was an environment in which the

[13] H. Garibean, The Beginning of Time (Oxford: UK: Clarendon Press, 1999), pp. 15-85.

planets and the geology controlled the events and the cycles of nature drove cyclic time. For these prehistoric people, the rising and setting sun governed life, as did the phases of the moon, the movement of the stars, the changing seasons, seasons of planting, the periods of waking and sleeping, menstruation, puberty, age, and death. The inner rhythms of the human being coincided with the external rhythms of nature. Traditional village lore makes use of the natural events as the marker of times, such as the migration of birds, the harvest, the growth of foliage, and vegetation. The cyclic time had an ecological and tribal aspect, in which events were shaped by ecological factors. The idea of reincarnation is an outcome of the cyclic time, in which there is no salvation or damnation.

The development of human society marks the beginning of serial rather than the cyclic time. The Qur'anic and the biblical concept of time is a product of the identification of order and the recognition of events in a meaningful sequence. This time is the serial time described in the Qur'an (96:1). This time is punctuated with a beginning and an end and runs in a straight line marking events from past to the present. Serial time is unidirectional and distinguished by continuous change and progress. One can experience it only once, earning salvation or damnation. The Christian calendar started 2000 years ago and is based on the rotation of the earth on its orbit around the sun and its own orbit. The Muslim calendar is based on the appearance of the new moon, as described in the Qur'an (2:189).

Earlier thinkers and philosophers considered space and time as two independent entities.[14] In the seventeenth century, Newton formulated his laws of motion and treated space and time as absolute entities where things move and take shape in a static

[14] J. B. Barbour, *The Discovery of Dynamics*: *A Study from a Machine Point of View of the Discovery and the Structure of Dynamical Theories* (Oxford, UK and New York: Oxford University Press, 2001), vol. I, pp. 35-115.

world.[15] Newton regarded time as a uniformly flowing entity. He had notions of acceleration, retardation, motion, force, and processes that occurred in the objective scientific time.[16] Time as lived by human beings was subjected to the discrete time of calendars and clocks identical for everyone. The time of science was a succession of measurable bits determined by the measurement of objects across space. This time is the same everywhere. Time entered Newton's calculations as an external parameter to measure change, a state of rest to motion and the rate of change of motion. The static universe was a deterministic concept of the universe based on matter with defined and predictable properties. Mulla Sadra,[17] who lived at about the same time as Newton, stated that time is neither absolute nor an external parameter. Time exists internally as a part of the process. It does not exist externally and has the dimensions of a physical quantity just like space. It arises only through mental analysis. Thus time, as a fourth dimension was already known in the philosophy of Mulla Sadra indirectly as two inseparable components, space and time.

In 1904, Einstein formulated his theory of special relativity,[18] in which he considered the velocity of light at 186,000 miles/sec a fundamental constant. He proposed that time and space were not absolute, as thought by Newton and others, but relative. They are elastic and can be changed with reference to a moving observer. For an observer who is stationary, the time of another observer traveling at a velocity, v, will be reduced by a factor of $(1-v^2/c^2)^{1/2}$. The clocks will be slowed down by that

[15] J. B. Barbour, *Absolute or Relative Motion: A Study fro Machian Point of View of the Discovery and the Structure of Dynamical Theories* (Cambridge, UK and New York: Cambridge University Press, 1975), vol. I, pp. 110-170.
[16] Paul C. W. Davies, *The Physics of Time Asymmetry* (Berkeley: University of California Pres, 1974), pp. 15-75.
[17] Fazlur Rahman, *Mulla Sadra and His Philosophy* (Chicago, IL: Chicago University Press, 1965), pp. 94 -113.
[18] Albert Einstein, *Relativity: The Special and the General Theory*, (London: Routledge, 1960).

factor. If the observer travels with the speed of light, his time becomes zero. Thus no material object can travel faster than the speed of light. If one considers a point in space to be a rod traveling in the same direction as light, the space will shrink to meet light and the time will expand. The reverse will happen on the return journey: the space will expand and the time will shrink or become faster. This will make the fast travelers in a spaceship coming back to earth younger than their counterparts on earth. Each observer with a different framework of velocity will have his or her own time. Thus time and space are not absolute but relative to each other. Since on earth we are traveling with the same uniform velocity of earth, time is the same for all of us.

The uniform motion of Newton or the free fall of a falling object was considered by Einstein to be equivalent to gravity in his general theory of relativity. Since gravity is constant, things of different weight fall on earth at the same time. In the general theory of relativity, gravity was expressed as the curvature of time and space.[19] At the point of enormous density of the dot at the Big Bang, gravity was infinite and time and space completely fused in one point. This is also the situation in the black hole where the time disappears due to enormous gravity. The Qur'an says: "Do not the unbelievers see that the heavens and the earth were joined together before We clove them asunder" (21:30).

The relativity of time is expressed in the Qur'an in several places. In the Qur'an (17:12, 25-26), the length of time that the people of the cave spent was a few hours for them and 300 years or so for others. God says, "The real duration of their sleep is known only to God." The relativity of time is also expressed in the Qur'an (22:47): "That a day in God's reckoning is equivalent to a thousand years of our time." "Angels and holy spirits will be presented to him in a day, the duration of which is 50 thousand

[19] Kip S. Thorne, *Black Hole and Time Warps: Einstein's Outrageous Legacy* (New York: W. W. Norton, 1994), pp. 87-121, 449-483.

years of our time" (70:4). The reference is obviously to different frameworks of time as applied to humans and angels.

The Arrow of Time

The arrow of time is an asymmetry in the past and the future. It is our subjective experience that occurs in time. Our consciousness, our emotions, and our feelings extend to the flow of time from the past to the present and to the future. The moment of the past remains in our memory, the time that glides through never comes back. What remains with us is "now," the one moment that slips away into the events of the unchangeable past to an unknown future. The stretch of time ahead of us stops at death, which is the result of an irreversible flow of time. If we can stop death, we can also stop the flow of time.[20] The ancient cultures embodied in the fear of time the fear of death. As expressed in the hadith: "Don't say anything bad about time, because time is God." The irreversibility of time spent on the earth is expressed in the Qur'an: those who would like to escape punishment and want to go back in their lives to correct their mistakes cannot do so. The entire duration of life is unidirectional, irreversible, and asymmetric.

The past is distinguished from the future as the unchangeable from the unknowable. The future is in fact not totally unknowable. From the facts and past experience of data, the future can be predicted to a certain extent. Nevertheless, an element of probability and uncertainty still remains with the future in contrast to the deterministic past.[21] The order of time, as measured by the mechanical laws of nature, is symmetrical with respect to the directions of past and future. However, the uncertainties associated with the future introduce an element of

[20] Clifford A. Pickover, *Black Holes: A Traveller's Guide* (New York: Wilet, 1996), pp.130-172.
[21] Michio Kaku, *Hyper Space: A Scientific Odyssey Through Parallel Universe, Time Warps, and the Tenth Dimension* (New York: Oxford University Press, 1994), pp. 273-353.

asymmetry and a resulting arrow of time. Some of the laws of motion are totally symmetric to the order in the forward and reverse directions of time. Thus, from Newton's laws of motion, the solar and lunar eclipses and the movements of planets can be predicted with reasonable precision. The asymmetry of past and future is governed not by the order of time, but by causal relationships. One can therefore generalize the qualitative aspects of time flow by the following facts: Time goes from past to future via a present "now." "Now" is a point in space time where action takes place. It is flow of time ordered in such a way that the past never comes back. We cannot make yesterday our "now." Although we cannot change the past, we can change the future to a certain extent. These statements reflect the connection between causality and time order. An event A may precede an event B and be its cause. Similarly, B can become the cause of A. These two connections then constitute a reversal of time order. In the special theory of relativity, time order is invariant. The time order can be reversed and the reversal causes a negative time in the other direction. The time invariance is used in Einstein's equation to evaluate the effect of motion on time and space.

It is important to note the difference between time order and time direction. Time order can be reversed as the reversal of time by the time direction, which establishes an asymmetry that cannot be reversed. This may be explained by a very simple example. If A is to the left of B, then B is not to the left of A, but to the right of A. This is an asymmetry of the relationship within "to the left." The relationship "to the right of" is the converse of the earlier relationship. Similarly, smaller than, larger than, earlier than, and later than also introduce asymmetry in the time direction. A later event cannot be the cause of the earlier event. Thus cause is differentiated from the effect in the fact that the cause always precedes the effect in time. This defines the asymmetry of time direction in terms of the causal direction. Two causal chains cannot form a closed cycle. If childhood and old age are two points A and B on a causal chain, one cannot have a closed chain

connecting B back to A. Otherwise one would return to childhood. This shows that because of the asymmetry of causal chain, the past can never come back.

Most of the mechanical laws worked out by Newton concerning velocity, motion, acceleration, and force are reversible with respect to time. The thermal processes using energy and heat are reversible in a closed system, but not in an open system. Clausius explained the relationship between heat and energy in the first law of thermodynamics, which states that the total energy of a closed system remains constant. The second law of thermodynamics deals with heat flow, work, and a quantity called entropy (S) defined as:

$$S = c * \log T + R/m * \log v,$$

Where c is the specific heat at constant volume, v is the volume of gas with unit mass, T the absolute temperature, and R the gas constant.

The change in entropy,

$$dS = dQ/T,$$

Where dQ is the change in heat absorbed or emitted by a system at the temperature T.

In a reversible process, the heat absorbed by one part is lost by the other. Thus, the total entropy change (dS) is zero. In an irreversible process, the entropy increases and $dS > 0$ is always a positive quantity. Entropy also becomes positive with the irreversible expansion of gas where v increases. Thus the entropy of a system in an irreversible process increases till a state of equilibrium is reached when $dS=0$. In a closed system, the decrease of entropy in one part is compensated by the increase of entropy in the other part, and the total entropy is zero.

Ludwig Boltzman brought a revolution to the idea of the entropy by defining entropy as the probability of occupancy of energy level states by a gas or a system.[22] The distribution of the energy levels according to Maxwell is such that the total energy E decreases. The relationship is given by, S=k+logW, where k is the Boltzman constant, and W is the probability of arrangements. An increase in W means a greater probability of occupancy and a disorderly arrangement, and an increase of entropy. Thus, an increase in entropy is defined as the extent of the disorder or chaos of a system with many probable occupancy states. The decrease in entropy is the change from disorder to order.

The Boltzman equation indicates that there is always a higher probability of an increase in entropy and occupancy of more energy levels. Since entropy is a probability, there is a much smaller chance of the entropy becoming negative. Such a process, if not impossible, has a very low probability. The physicist at this stage is confronted with two contradictory situations. The laws of motion and collision of molecules are governed by classical mechanics and are reversible with respect to time order. The macro-processes as governed by the Boltzman distribution of energy levels are irreversible with respect to time direction. This brings in a paradox in the laws of nature.

In the statistical picture of Boltzman, if the asymmetry increases towards the future, it should also apply to the past. There should be a higher entropy microstate in the past. However, this is not the situation. The fact that the entropy was much lower in the past conflicts with the statistical consideration. Poincaré[23] came to the rescue of the situation in 1889, when he pointed out that entropy-reducing behavior is not only possible but also inevitable,

[22] Ludwig Boltzmann, *Lectures on Gas Theory*, trans. Stephen G. Brush (Berkley, CA.: University of California Press, 1964).
[23] H. Poincaré, *Science and Hypothesis* (London, U.K: Walter Scott, 1905), pp.85-130.

if enough time is given to the system. Under certain conditions a system is bound to come arbitrarily to any possible state, even that of low entropy. This is known as Poincaré's recurrence theorem, which implies a reversal of condition to low entropy levels, given enough time. Boltzman argued that the low entropy condition of the universe in the past was the outcome of an anthropic principle in cosmology. This principle states that for the development of intelligence on the earth, a constant flow of energy is needed from the sun to the earth. This condition is achieved by the entropy gradient, which is strongly asymmetric, and the direction of its increase takes us to the future in the direction of time.[24]

Another very obvious phenomenon of the asymmetry of the direction is the arrow of radiation. When we throw a stone into water, the ripples always spread outward rather than inwards. This represents in general the wave producing phenomenon in nature and the asymmetry is called the arrow of radiation. Maxwell's theory of electromagnetic radiation, developed in 1850, has two solutions. One is called the retarded solution corresponding to the spreading waves, and the other the advance solution corresponding to the converging waves inverse. Although Maxwell's mathematical solutions permit both situations, nature selects only one, the retarded solution. Einstein was aware of the problem and suggested that the thermodynamic asymmetry and radiation asymmetry are due to reasons of probability and both depend on the initial conditions of the universe. Thus the two arrows show a common explanation, which is the initial conditions of the universe or a cosmological arrow of the expansion of the universe. The theory of radiation developed by Feynmann and Wheeler in 1940 is based on the asymmetry of radiation depending on the thermodynamic asymmetry of entropy. [25] The radiation is fundamentally symmetric, yet what we see is only the retarded radiation, selected from the two possibilities by a cosmological

[24] K. Popper, "The Arrow of Time," *Nature* (1956), pp. 177, 538.
[25] See J. A. Wheeler and R. P. Feynmann, *Review of Modern. Physics* (1945), vol. 17, pp. 157-181.

arrow. If we consider water waves going to the edges of a pond to be lost by friction, a recombination of forces bringing them back to the center of the pond is impossible. We cannot get the stone ejected from the water. Zeh also pointed out that the radiation arrow might be derived from the thermodynamic arrow out of reasons going back to the origin of the universe. [26] The arrow of radiation thus provides a further important case of the general tendency displayed by the arrow of entropy and the arrow of time from past to future.

The temporal asymmetry explained in Boltzman's thermodynamic and Maxwell's radiation asymmetries, seems to be now cosmological in origin. These are related to very special conditions of the beginning of the universe after the Big Bang.[27] These conditions indicate very low entropy in the beginning and a smooth distribution of matter with about the same density everywhere. This is expressed in the Qur'an as follows:

> He Who has created has created the seven heavens one above the other. You will see no lack of proportion in the creation of the Most Gracious. So look again: do you see any flaw? Look a second time: your vision will come back to you, dull and discomforted, in a bewildered state. (67: 3-4)

Without the smooth distribution of matter in the early universe, gravity would have collected this into large clumps or the black holes. Even too smooth a universe would have resulted in the formation of atoms, without the collection of matter in galaxies. Thus the initial conditions of the universe in terms of the low entropy and the uniform distribution of matter are results of temporal asymmetry.

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[26] Heinz Deiter Zeh, *The Physical Basis of the Direction of Time* (Berlin, Germany and New York: Springer-Verlag, 1992), pp. 85-115.
[27] S. W. Hawking, Roger Penrose, *The Nature of Space-Time* (Princeton, NJ: Princeton University Press, 1996) pp. 75-105.

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Thomas Gold, in early 1960, suggested that the entropy might be low at both ends of the universe. [28] An early appealing idea was the fact that there may be a strong connection between the expanding universe and the second law of thermodynamics. The thermodynamic arrow may then lead to new possibilities that matter may take up. In the reverse process of the contracting universe the reverse would happen. Gold's contracting universe is thus a mirror image of the expanding universe.

Stephen Hawking and Henry Penrose[29] are of the opinion that the starting point of the universe (the Big Bang) and the end point of the universe (the Big Crunch) are not identical singularities. If we consider the singularities at the beginning and end of the universe similar to black holes, they are not identical. The Big Bang is a point with zero curvature, whereas the Big Crunch is expected to be more irregular with a marked curvature. Thus information is lost in the beginning of the universe and stored at the end. An elaborate theory based on future and past world lines in space-time predicts singularities in the future owing to the gravitational collapse of the stars, which marks the end of time. The smaller black holes of the stars may join to form a resultant black hole at the Big Crunch. At both the ends we have gravitational entropy, which is the result of extreme gravitational fields at the two ends. The gravitational entropy, like the thermodynamic entropy, is additive quantities. The singularity at the Big Crunch will be the addition of many black holes and the sum of gravitational entropies of the individual black holes. The Big Crunch singularity is different from the Big Bang singularity and sets up a comic asymmetry in the universe and a time arrow from the past to the future. Inspite of many theories in cosmology, science has not yet understood why the past singularity at the point of the beginning of the universe should be so special. Henry

[28] T. Gold, *The Nature of Time* (Ithaca, NY: Cornell University Press, 1967), pp. 95-140.

[29] Hawking, Stephen *The Universe in a Nutshell* (New York: Bantam Books, 2001) pp. 101-135.

Penrose has estimated that this special feature is attained in one part out of $(10^{10})^{123}$. All this leads to an act of the Supreme Creator as described in the Qur'an:

> He is God, the Creator, the Evolver, the Bestower of Forms; to Him belong the Most Beautiful Names: all that is in the heavens and on earth declare His Praises and Glory; and He is exalted in Might, the Wise. (59:24)

Time is very much related to our consciousness as an inseparable component. We feel that time is running slow or fast depending on our state of mind. For a person in distress, time runs extremely slow, but flies for someone who is fully occupied. Thus the notion of time is related to our inner feelings. For paranoid patients who have forgotten their past, life becomes meaningless. Bergson described two types of time: scientific time that can be measured and an inner time that has no duration.[30] One can escape the domain of serial time by entering into the inner self where time is continuous. The time becomes "pure duration" that cannot be described, but only felt. Thus we cannot separate time from our consciousness, since it is part of our being.

The present arrow of time is based on the expansion of universe. The question is: For how long will the expansion continue? It can expand till a state of equilibrium is reached. At this stage the entropy will be zero and all the energy will be in the form of heat. This amounts to the "heat death" of the universe. In order to avoid this heat death, the universe will start to contract. Since the contracting world will have marked asymmetry and curvature, this will cause entropy to increase. It is a matter of conjecture that at the approach of the Big Crunch, the Boltsman probability facture *k* may come into effect, followed by a change from disorder to order and a lowering of entropy.

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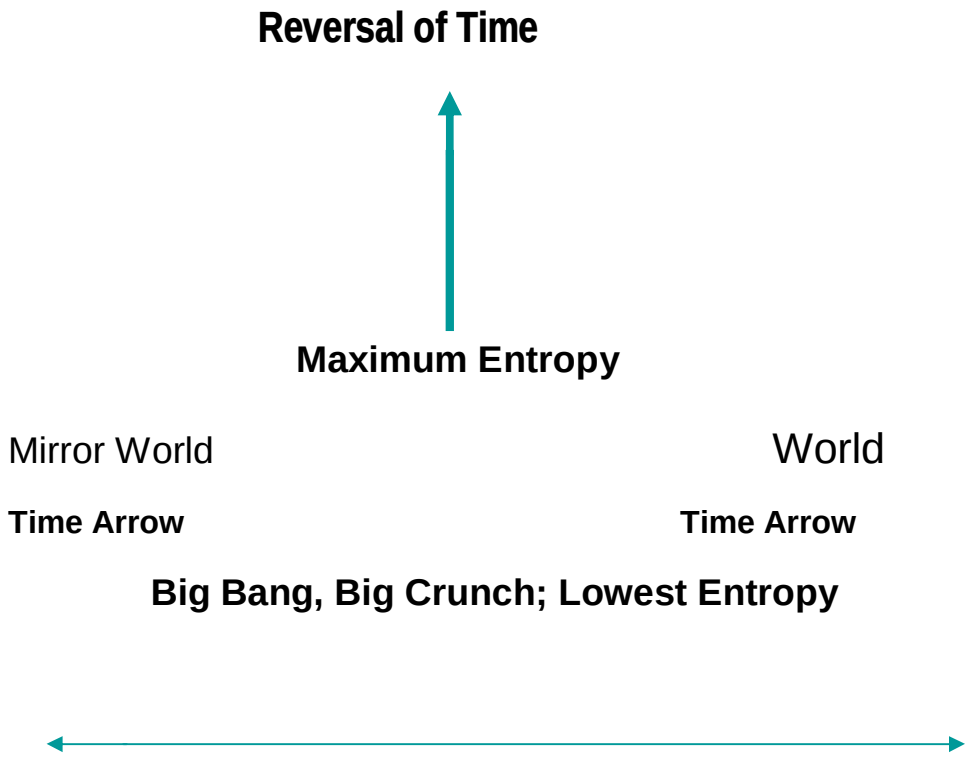
[30] Henri Bergson, *Mind and Matter* (Oxford, UK: Oxford University Press, 1964), pp. 70-100.



There are certain misconceptions regarding the idea of the reversal of time.[31] People think that the reversal of time means the reversal of the laws of nature. For example, water will start to flow upwards and will boil spontaneously in a pan. This also does not mean that a shattered cup with the drink spilled on the floor will suck back liquid from the floor, the pieces will come together

[31] H. Price, *In Time's Arrow Today: Recent Physical and Philosophical Work on the Direction of Time",* ed. S. Savitt (Cambridge, UK: Cambridge University Press, 1994), pp. 95-115.

and the cup will jump back on the table. This is because of the fact that there is not a unique solution to the problem of going backwards. The chain of causes, however, will lead to states of lower and lower entropy pointing towards the past. One of the fundamental laws of nature is that cause precedes effect. The reversal of time will not affect this fundamental law of nature. Ultimately the singularity of the Big Crunch will be reached as described beautifully in the Qur'an in several places. "When the sun will be rolled back in diameter" (81:1).

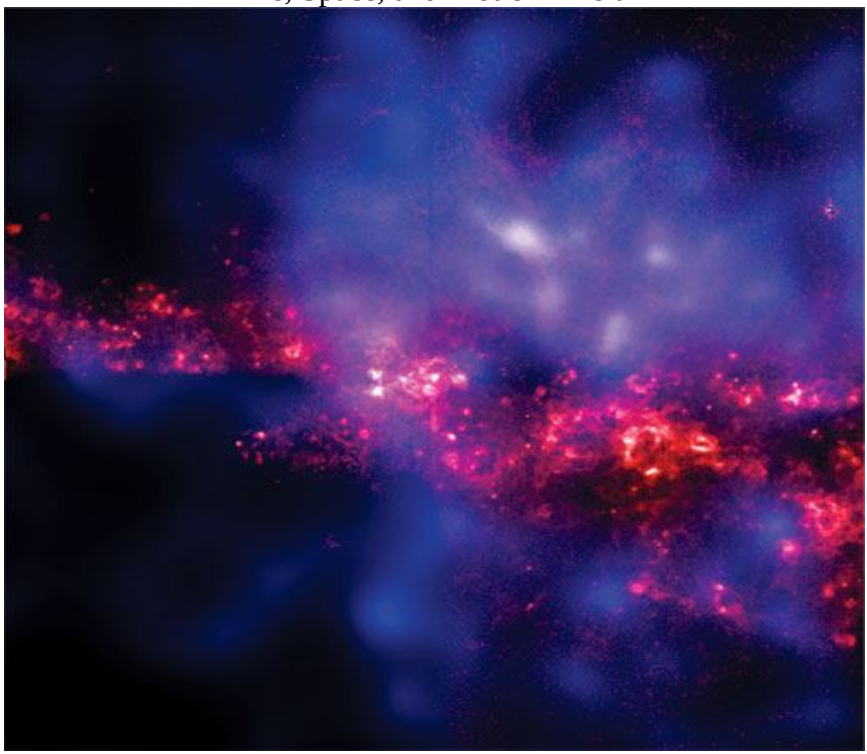
The Day of Resurrection is an event when the people will rise from the graves. It is not the effect of time reversal. It will be only on the day when the singularity will be reached and "the spirit and body will be brought together."[32]

What is the extent of interaction between the physical world and the mental world? Since time and space are associated with matter they are very much part of our consciousness. In the macroscopic world we cannot be separated from the arrow of time. It is relative and very personal. If one solves the general relativity equations, the total energy of the cosmos becomes zero. The variation of energy with time is the only handle on time in the micro and macro worlds. With the disappearance of energy this handle is lost with the elimination of time. Thus one enters a timeless domain with bits of space floating without any connection.[33] These floating bits are slices with two parameters, configuration of space, h, and a generalized field, f, where every slice can evolve into time. This is equivalent to many possibilities or, in the words of Everett, many worlds with their own initial history and a starting point in time. God says in the Qur'an that He is capable of creating many worlds like ours. Therefore He is referred to as the Sustainer of many worlds. There are possibilities

[32] Frank Tipler, *The Physics of Immortality: Modern Cosmology, God and the Resurrection of the Dead* (Doubleday, NY: Anchor Books, 1995), pp. 124-167.
[33] Julian B. Barbour, *The End of Time, the Next Revolution in Physics* (Oxford, UK: Oxford University Press, 2000), pp. 323-335

The Directionality and Relativity of Time and Space given by general relativity with timeless bits, each evolving with a history of a beginning and an end.

If we take the history of the universe close to the Big Bang or the Big Crunch, it is a timeless, spaceless zone with infinite possibilities of space configurations. This is the region of quantum gravity, which is not computable according to Penrose [6]. Of these possibilities, which are there in the protected Tablet, as described in the Qur'an (85:21, 22) one is chosen by God on the application of His orders of "Be and it is," the Qur'an (36:82). By this only one possibility takes shape. This sets up the initial conditions of Planck's length, Planck's time, and the speed of light. This is equivalent to the application of quantum conditions on configuration space, which generates time. The entire history of the world, which is remarkably organized from the Big Bang to the Big Crunch, is in the knowledge of God, Who is the Omnipotent and Omniscient. Our consciousness is tuned to the sequence of events in such a way that an arrow of time is created. Every motion that we see is a sequence of snaps presented very rapidly before our conscience like a running film, which creates motion. There are two levels of our consciousness: at a lower level we are tuned to serial time and at a higher level we can escape time and enter into a zone of continuous time or pure duration. Beyond this it is the time of God (*al-sarmad*), the Creator, the Planner and the Designer, as described in the Qur'an (59:24).



1138_xray: The composite image of spiral galaxy NGC 4631:This image shows central region of the spiral galaxy NGC 4631 as seen edge-on from the Hubble Space Telescope. The data, shown in blue and purple, provide the first unambiguous evidence for a halo of hot gas surrounding a galaxy that is very similar to our Milky Way. The structure across the middle of the image and the extended faint filaments, shown in orange, represents the observation from Hubble that reveal giant bursting bubbles created by clusters of massive stars. Scientists have debated for more than 40 years whether the Milky Way has an extended corona, or halo, of hot gas. Observations of NGC 4631 and similar galaxies provide astronomers with an important tool in the understanding our own galactic environment.
http://www.msfc.nasa.gov/news/photos/photogallery/chandra/chandra5.htm